

ABSTRACT FOR SPRING 1995 MRS MEETING

Submitted to Symposium G

Symposium Title: Structure and Properties of Multilayered Thin Films



MEASURING ENTHALPIES OF FORMATION USING THICK MULTILAYER FOILS AND DIFFERENTIAL SCANNING CALORIMETRY, T.P. Weihs, T.W. Barbee, Jr. and M.A. Wall, Chemistry and Materials Science Department, Lawrence Livermore National Laboratory, Livermore, CA, 94551.

The ability to measure formation enthalpies of compounds at relatively low temperatures using thick multilayer foils and differential scanning calorimetry is demonstrated. The enthalpy of formation (ΔH_f) of Cu-Zr and Al-Zr transition metal alloys were measured using thick ($\geq 25\mu\text{m}$), free-standing Cu/Zr and Al/Zr multilayer foils. The multilayers were deposited onto Si or glass substrates using a planetary, magnetron source sputtering system. The as-deposited foils were removed from their substrates, cut into 6mm diameter specimens, and scanned in temperature from 50°C to 725°C in a differential scanning calorimeter (DSC). In the case of the Cu/Zr multilayers, three distinct exothermic reactions were systematically observed for Cu-rich samples. The heats from the first two reactions sum to give 13.9 kJ/mol for the enthalpy of formation of $\text{Cu}_{51}\text{Zr}_{14}$. This quantity is in good agreement with the single value of $\Delta H_f = 14.07\text{kJ/mol}$ that has been reported for this Cu-Zr alloy. With the Al/Zr multilayers, a broad range of compositions were studied. Heats of formation are reported for five different Al-Zr alloys with Zr concentrations from 10 to 67 at% Zr, and the results are compared with literature values of ΔH_f . Advantages of measuring enthalpies of formation using thick multilayer foil samples and low temperature DSC calorimetry in place of high temperature reaction calorimetry are discussed.

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